

## CLAIMS

What is claimed is:

- 1 1. A method comprising:  
2 mounting an integrated circuit on a top surface of a package substrate having  
3 top and bottom surface buildup layers disposed on a thermally conductive substrate  
4 core, wherein a portion of the substrate core is exposed at the top surface of the  
5 package substrate; and  
6 attaching a heat spreader to the package substrate, the heat spreader thermally  
7 coupled to the exposed portion of the substrate core and to a backside surface of the  
8 integrated circuit.
- 1 2. The method of claim 1, wherein attaching the heat spreader comprises soldering  
2 the heat spreader to the exposed portion of the substrate core.
- 1 3. The method of claim 1, wherein mounting the integrated circuit comprises  
2 mechanically and electrically coupling the integrated circuit to the top surface of the  
3 package substrate by a plurality of solder bump interconnections.
- 1 4. The method of claim 1, wherein the exposed portion of the substrate core  
2 extends around the perimeter of the top surface buildup layers.
- 1 5. The method of claim 1, comprising depositing a thermal interface material  
2 between the backside surface of the integrated circuit and the bottom surface of the heat  
3 spreader.
- 1 6. The method of claim 1, comprising attaching a heat sink to a top surface of the  
2 heat spreader.

Sub 1 7. An apparatus comprising:

Application

2 a package substrate having top and bottom surface buildup layers disposed on a  
3 thermally conductive substrate core, wherein a portion of the substrate core is exposed  
4 at a top surface of the package substrate to allow for attachment of a heat spreader.

1 8. The apparatus of claim 7, wherein the exposed portion of the substrate core  
2 extends around the perimeter of the top surface buildup layers.

1 9. The apparatus of claim 7, wherein the substrate core is made of metal.

1 10. An apparatus comprising:  
2 a package substrate having top and bottom surface buildup layers disposed on a  
3 thermally conductive substrate core;  
4 an integrated circuit having a top surface and a backside surface, the integrated  
5 circuit mounted on a top surface of the package substrate with the top surface of the  
6 integrated circuit facing down; and  
7 a heat spreader thermally coupled to the substrate core, a bottom surface of the  
8 heat spreader thermally coupled to the backside surface of the integrated circuit.

1 11. The apparatus of claim 10, wherein the heat spreader is thermally coupled to a  
2 perimeter portion of the substrate core.

1 12. The apparatus of claim 10, wherein the heat spreader is soldered to the substrate  
2 core.

1 13. The apparatus of claim 10, wherein the heat spreader is made of metal.

1 14. The apparatus of claim 10, wherein the substrate core is made of metal.

1 15. The apparatus of claim 10, comprising a thermal interface material disposed  
2 between the backside surface of the integrated circuit and the bottom surface of the heat  
3 spreader.

1 16. The apparatus of claim 10, comprising a heat sink attached to a top surface of  
2 the heat spreader.

1 17. The apparatus of claim 16, comprising a fan attached to the heat sink.

1 18. The apparatus of claim 10, wherein the integrated circuit is mechanically and  
2 electrically coupled to the package substrate by a plurality of solder bump  
3 interconnections.

1 19. The apparatus of claim 18, comprising a printed circuit board, wherein the  
2 package substrate is mounted on the printed circuit board.

1 20. The apparatus of claim 19, wherein the package substrate is mechanically and  
2 electrically coupled to the printed circuit board by a plurality of solder bump  
3 interconnections.

1 21. An apparatus comprising:  
2 a package substrate having top and bottom surface buildup layers disposed on a  
3 thermally conductive substrate core;  
4 at least two integrated circuits having top surfaces and backside surfaces, the  
5 integrated circuits mounted on a top surface of the package substrate with the top  
6 surfaces of the integrated circuits facing down; and

7 a heat spreader thermally coupled to the substrate core, wherein a bottom  
8 surface of the heat spreader is thermally coupled to the backside surfaces of the at least  
9 ~~two integrated circuits~~

1 22. The apparatus of claim 21, comprising one or more capacitors mounted on a top  
2 surface of the package substrate.

1 23. The apparatus of claim 21, wherein the heat spreader is soldered to the substrate  
2 core.